



Deepwater Horizon BP Oil Spill: Modeling the Potential Long Term Movement of Oil

Objective

The National Oceanic and Atmospheric Administration (NOAA) has used computer models to estimate the potential threats to U.S. coastlines that might result if oil spilling from the Deepwater Horizon site continues until a relief well successfully stops the flow. Although it is impossible to predict precisely where surface oil will go in the coming months, it is possible to analyze where surface oil is most likely to go by (a) using historical wind and ocean current records; and (b) accounting for both natural processes of “weathering” and human intervention to recover and remove the oil. This report will be updated as more information becomes available.

Major Findings and Implications

The details of the study are outlined in the following pages, but the major findings are represented in the figures on the next page and include:

- The coastlines with the highest probability (81% – 100%) for impact -- from the Mississippi River Delta to the panhandle of Florida-- are already receiving oil.
- Along U.S. Gulf of Mexico shorelines, the oil is more likely to move east than west, with the south coast of Texas showing a relatively low probability (less than 1%) for impact.
- Much of the west coast of Florida has a low probability (1% – 20%) for impact, but the Florida Keys, Miami and Fort Lauderdale areas have a greater probability (61% – 80%) due to the potential influence of the Loop Current.
- A projected threat to the shoreline does not necessarily mean that oil will come ashore. It means that oil or streamers or tar balls are likely to be in the general vicinity (within 20 miles of the coast). Winds and currents will have to move the oil or tar balls onto the shore. Booms and other countermeasures would be used to mitigate the potential coastal contact once oil is in the area.
- The longer it takes oil to travel, the more it will degrade, disperse, lose toxicity, and break into streamers and tar balls. For example, any oil that enters the Loop Current will take at least 8 to 12 days to reach the Florida Straits, but could take much longer. Over that time, the oil will degrade and disperse, and any shoreline impacts to Keys, southeast Florida or beyond would be in the form of scattered tar balls, not a large surface slick of oil.
- As the Gulf Stream moves northeast and angles away from the continental US, there is an increasingly lower probability of shoreline impacts from eastern central Florida up the eastern seaboard. If oil does reach these areas, it will be in the form of tar balls or highly weathered streamers after traveling a thousand miles or more through the ocean.
- Implications. The findings cover potential impacts based on a scenario that assumes a significant continuing spill. Some of these impacts may be weeks or months away or may not

materialize. In light of these uncertainties and extended timeframes, NOAA will continue to work with the U.S. Coast Guard and other members of the response team to track the movement of oil, including monitoring the Loop Current, producing 72-hour projections of oil movement and updating these longer-term models, to inform states, communities, businesses, consumers, and others. Updated information can be found at: http://response.restoration.noaa.gov/deepwaterhorizon/longterm_outlook

The two graphics below depict the composite results of 500 individual scenarios or runs of the model. The model assumes that oil is released at an average rate of 33,000 barrels per day for 90 days. The model predicts the location of oil after 120 days from the start. Figure 1 shows the probability of shoreline threats that resulted in enough oil to cause a dull sheen within 20 miles of shore. However, a projected threat to the shoreline does not necessarily mean that oil will come ashore. Figure 2 shows the percentage of spill model scenarios that resulted in enough oil to cause a dull sheen in a given 20 by 20 mile grid.

Figure 1: Probability of Shoreline Threat, as of Day 120, for a 33,000 barrels/day release for 90 days

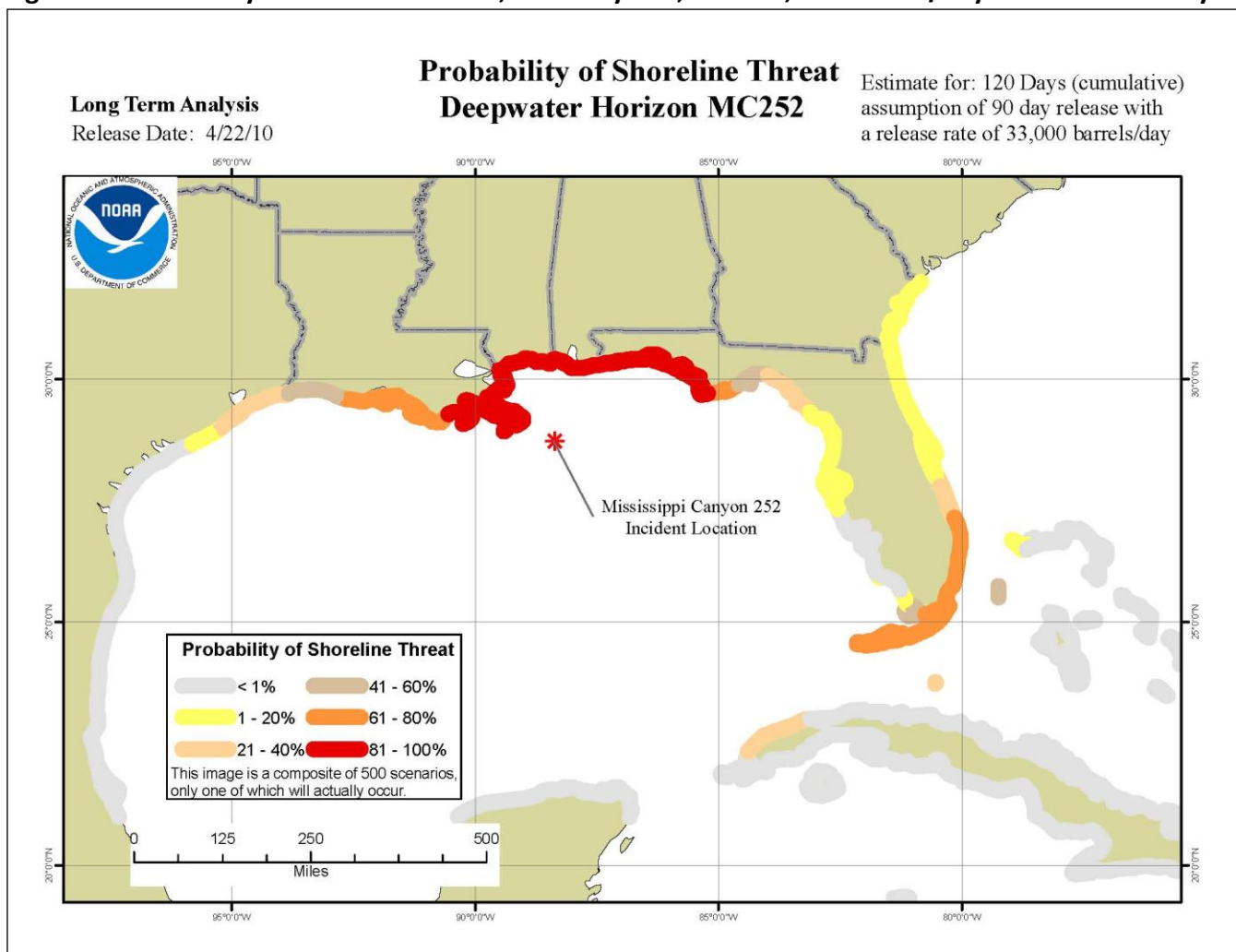
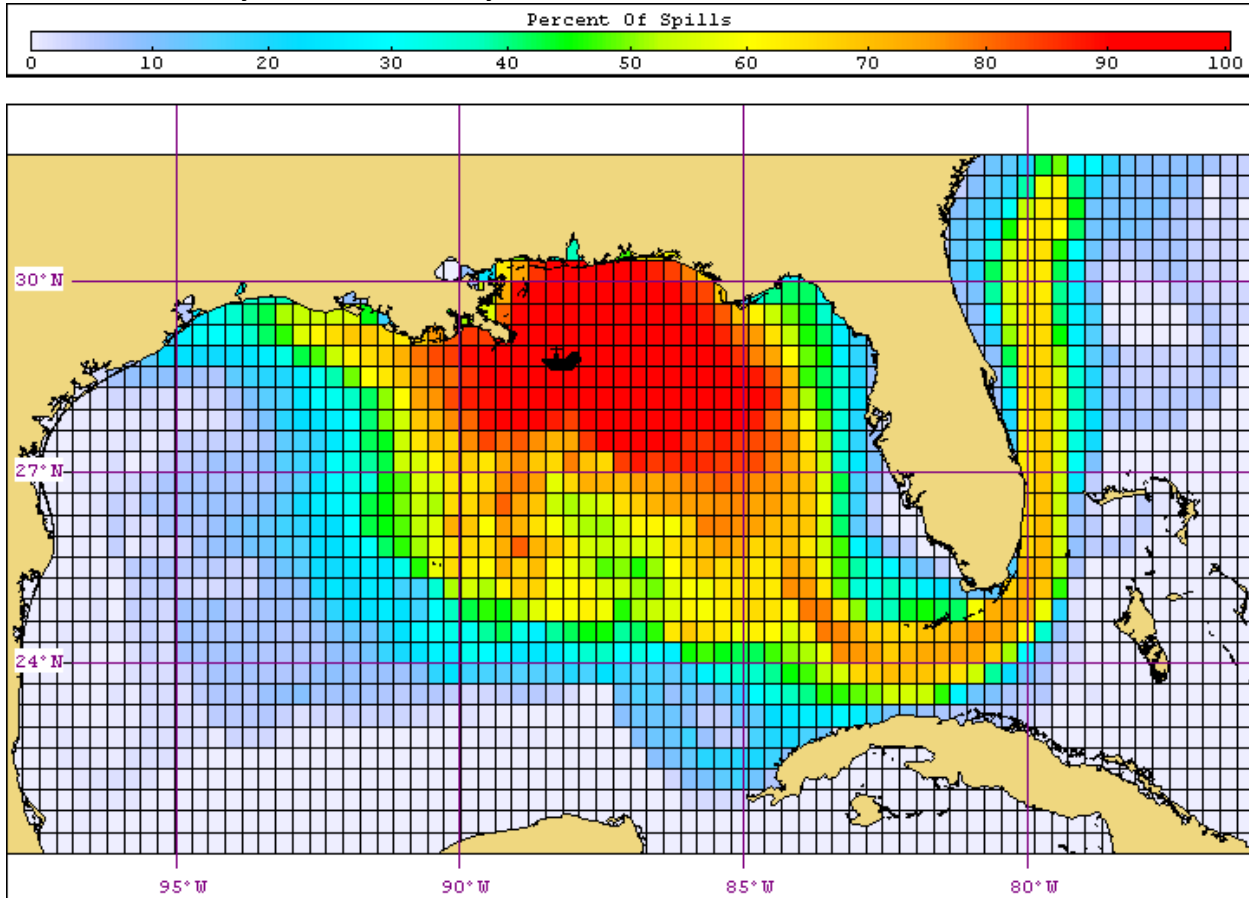


Figure 2: Percent of Spill Scenarios that would cause a dull sheen in a given grid as of Day 120 for a 33,000 barrels/day release for 90 days



Project Overview

The amount of oil being released by the Deepwater Horizon well has triggered widespread concern. Reports about the Loop Current, which could carry oil from the Gulf of Mexico around the tip of Florida, have expanded the geographic scope of interest. Responders across the Gulf and on the East Coast have been asking whether they should be preparing for the arrival of Deepwater Horizon oil. The public wants to understand the possible geographic scope of the environmental and economic impacts of the spill. Although there are limits to forecasting future impacts, this analysis provides some insights on the likelihood of various outcomes.

Beyond the continuing intensive efforts to contain, recover, and remove the oil, the Federal government will closely monitor the movement of the oil over time, particularly focusing on the relationship between the Loop Current and the oil slick to help sharpen the outlook for impact to South Florida and neighboring Caribbean nations. This information will give coastal states and communities warning about potential threats of shoreline impacts to ensure that adequate preparedness measures can be taken.

At present, the Loop Current does not appear to be a major source of transport of Deepwater Horizon oil to the Florida Straits or Gulf Stream. The top of the Loop Current has pinched off as an eddy that is spinning clockwise in the Gulf, recirculating within the Gulf any oil that it has entrained. NOAA will continue to follow the eddy and the Loop Current closely.

To perform the analysis of potential for long-term impact to shorelines, NOAA ran the computer model using 15 years of data on past winds and ocean currents in the Gulf of Mexico. NOAA ran this model five hundred times to reflect the uncertainty in forecasting future winds and ocean currents; each model run used a randomly selected subset of the 15-year data set. Each run of the computer model predicts oil movement over a 120-day period. It is important to note that although modeling is useful in characterizing what is more or less likely to happen, it cannot provide precise predictions about oil movement. The modeling is based on a 120 day projection starting from day one of the spill. It does not take the current footprint of the spill—which, approximately 70 days after the start of the spill, has not entered the Loop Current—as the starting point.

A peer review of the data and NOAA method was conducted by experts from the U.S. Navy, Minerals Management Service, Texas A&M, Texas General Land Office, Scripps Institution of Oceanography, and BP. The final modeling analysis reflects their technical input.

Assumptions and Caveats

In running this computer model, NOAA used the following parameters and assumptions:

- One key assumption in modeling the spill is the flow rate of oil into the Gulf of Mexico. The scenario assumes two different rates (one prior to the cutting of the riser pipe and a second one after the cutting of the riser pipe), then it subtracts out the oil removed from the environment, e.g., by skimming and burning. A gross flow rate of 40,000 barrels per day is used from the sinking of the Deepwater Horizon on April 22 until the cutting of the riser pipe on June 3. This number represents the upper bound of the estimate developed by the National Incident Command Flow Rate Technical Group (FRTG). After the cutting of the riser pipe, the model assumes that the gross flow rate increases to 60,000 barrels per day, again at the upper limit of the range provided by the FRTG (the lower bound is 35,000 barrels/day). These gross flow rates are then adjusted to account for the various mitigation efforts – skimming, oil burning, and subsurface oil collection – to calculate a *net* flow of 33,000 barrels per day for 90 days. The net flow rate reflects an average of 7,000 barrels per day for oil burning and skimming throughout the 90-day period, and an average of 20,000 barrels per day for subsurface containment through the top hat system after it was put in place on June 5. These adjustments are averaged over the 90 days of flow which reflects the approximate three-month window necessary for a relief well to be drilled. The model does not account for the use of dispersant in reducing the overall volume of surface oil.
- The estimated net flow of 33,000 barrels per day was used as a conservative but reasonable estimate that may overstate coastal risk somewhat. Other reasonable scenarios were examined that involved different gross flow rates and benefits from mitigation efforts, but the overall pattern of shoreline threat was not appreciably changed, so the 33,000 barrel per day scenario was selected for presentation. For example, sub-surface containment has exceeded 20,000 barrels per day for short time periods, and the sub-surface capacity to capture more than 50,000 barrels per day is expected to be operational by the beginning of July. The efficacy of skimming and burning operations varies with the weather, so calm weather may increase the daily removal rate through these mitigation measures, while rough weather may decrease the daily removal rate. The risk that a hurricane may require the relocation of surface vessels participating in the subsurface collection of oil, however, could result in a higher rate of flow from the well for some period of time. Finally, uncertainty about the

timing of completing the relief well obviously affects the duration of the spill. As better information becomes available, updated analyses will be posted at the web link cited at the end of this fact sheet.

- The model assumes that the “weathering” of the oil – the process by which oil naturally breaks down and changes in the environment – occurs in a way that is typical of oils similar to the Deepwater Horizon oil. The longer it takes oil to travel, the more it will degrade, disperse, lose toxicity, and break into streamers and tar balls. Again, the model does not account for the use of dispersants.
- The model considers oil a threat to the shoreline if there is enough oil to cause a dull sheen within 20 miles from the coast. A dull sheen was used as the threshold because that is enough oil to be toxic to some organisms in the water column and potentially require the closure of fisheries. Anything less than a dull sheen, the model does not consider to be a threat to the shoreline.
- A threat to the shoreline does not necessarily mean that oil will come ashore. Winds and currents will have to move the oil or tar balls onto the shore. Booms and other countermeasures would be used to mitigate the potential coastal contact. Therefore, the model may over-estimate the degree of potential shoreline threats from the spill.

Interpreting the Analysis

The probability map shown is a composite of the 500 individual scenarios for a net release of 33,000 barrels per day for 90 days. The colors indicate the percentage of the scenarios that resulted in enough oil to cause a dull sheen within 20 miles of shore or the 20 by 20 mile grid over a 120-day period. Main findings are summarized on page one.

There are several important factors to remember when interpreting the results:

1. The probability maps display the cumulative outcome of 500 individual scenarios. For example, if 250 of the 500 scenarios displayed a shoreline threat for a particular coastal area, the probability for shoreline threats at that area would be 50%. However, it is important to understand that only one scenario will actually occur. In other words, not all the areas with probabilities for shoreline threats will actually be affected. The winds, currents, flow rate, and mitigation efforts that actually occur during the release period will determine oil movement.
2. This model considers surface oil only. The longer it takes oil to travel, the more it will degrade, disperse, lose toxicity, and break into streamers and tar balls. For example, any oil that enters the Loop Current will take at least 8 – 12 days to reach the Florida Straits, but could take much longer. Over that time, the oil will degrade and disperse, and any shoreline impacts to southeast Florida or beyond would be in the form of scattered tar balls, not a large surface slick of oil.
3. NOAA is closely monitoring the movement of oil from the Deepwater Horizon spill through aerial and satellite observations. NOAA is also providing daily forecasts to predict where the oil is going to go within the next 72 hours. Although the Loop Current is not presently a significant source of transport of oil to the Florida Straits, should a significant amount of surface oil enter the Loop Current and begin to move toward the Florida Straits and eastern

seaboard, NOAA will be able to see it, predict the movement, and help guide preparedness, response and cleanup efforts.

4. Oil movement could continue beyond the 120-day time frame used in the model runs.
5. Unlike the 72-hour projections reported daily by NOAA, the long-term model reported here does not initiate with the current footprint of the oil spill as the starting point – it initiates with a release from the source on Day 1. To date, about 70 days after the start of the spill, a significant amount of oil has not entered the Loop Current because of the specific location and configuration of the currents, though in some of the modeling runs, oil is projected to have done so. In that key respect, conditions thus far have been more favorable in reality than some of the 500 model runs generated would represent.

NOAA will continue to revise this model as new data are gathered. Updated scenarios and more information about the model can be found at:

http://response.restoration.noaa.gov/deepwaterhorizon/longterm_outlook